

Hopkins (G. S.)

FROM
PROCEEDINGS
OF THE
American Society of Microscopists.

THIRTEENTH ANNUAL MEETING,
DETROIT, MICH.

1890.



STRUCTURE OF THE STOMACH OF *AMIA CALVA*.

GRANT S. HOPKINS, B. S., Cornell, '89, Ithaca, N. Y.

The stomach of *Amia calva** presents the same general appearance as is seen in other members of this or of higher groups, but a close examination reveals a condition found in but few fishes and in none of the higher animals.

The muscular fibers of the stomach are arranged, as is usual, into three coats—the longitudinal, circular, and oblique. The ectal longitudinal coat is extremely thin, and in places does not form a continuous layer. The inner coat is incomplete, being confined mainly to the cardiac end of the stomach. As the œsophagus enters the stomach the transversely striated muscular fibres are gradually replaced by smooth muscular fibers, the latter kind alone being found in the pyloric half of the stomach and in the intestine.

It is, however, to the mucous membrane of the stomach that special attention will be given. The most interesting feature noticed here is the existence of a ciliated epithelium. So far as I know, this ciliated character of the stomach of the *Amia* was first discovered by Prof. S. H. Gage in 1886.

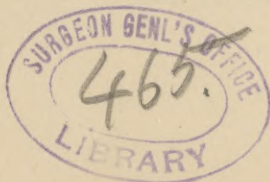
The ciliated epithelium extends uninterruptedly from the beginning of the œsophagus to within about one centimeter of the pylorus.

The direction of the ciliary currents is from the cardiac towards the pyloric end of the stomach.

In order to determine whether this ciliated stomach was really a digestive organ or not the following experiment was tried: A large tadpole was given to the fish; two and one-half hours afterwards the fish was killed and the contents of the stomach examined. The tadpole was found partially digested, small pieces of muscle, nerve, etc., being found in the stomach in great abundance, showing conclusively its digestive character.

When empty, the mucous membrane of the stomach is thrown into longitudinal folds or rugæ, and it also has that soft, velvety appearance characteristic of the lining membrane of this organ.

* Aganoid fish, the dog fish or lawyer.



The cells of the surface epithelium are extremely long and slender. Each cell contains a rather large, oval nucleus situated at a variable distance from the free end. This variation of level in the situation of the nuclei often gives the epithelium the appearance of being stratified. The attached ends of the cells are continued into long thread-like processes, upon some of which are visible slight enlargements. These thread-like processes of the cells do not stop at what appears to be the basal surface of the epithelium, but they extend down into the mucosa.

Ludwig Edinger says that a ciliated epithelium never exists in the stomach of fishes. Trinkler, however, found ciliated cells in great numbers in the stomach of two bony fishes, the perch and the pike.

As to the glandular character of the stomach of the *Amia*, I find the two common kinds of glands, the so-called cardiac and pyloric glands, the former being the more numerous. The mouths of the cardiac glands are lined by ciliated epithelium, the deeper portion by granular cells of a more nearly cubical or spherical form.

The depth to which the ciliated epithelium extends into the mouth of a tubule compared to the whole length of the tubule is as 1 to 4.5, very nearly. These glands extend to within about 1.5 c. m. of the pylorus, where they are replaced by the pyloric glands. The latter are lined throughout their whole extent by columnar cells, having the same appearance as those of the surface, but somewhat shorter. In many cases two or more glands open into a single mouth. For a distance of about $\frac{1}{2}$ c. m. caudad of the point where the pyloric glands first appear they are lined by ciliated epithelium as in the cardiac glands. To what depth the cilia extend into the mouths of the glands possessing them could not be determined from the specimens at hand, but by further examination I hope to settle this point. The greater number of these glands, however, have no cilia.

Methods.

The methods here given are those used in the anatomical laboratory of Cornell University.

NITRIC ACID METHOD.

For demonstrating the muscular layers of the stomach it is placed in nitric acid (20 per cent.) for a short time. No definite length of time for leaving it in the acid can be given, as it varies in different cases, due chiefly to variations of temperature. When the connective tissue is sufficiently softened the muscular coats can be separated from each other very satisfactorily.

This is a most excellent method also for obtaining isolated gastric tubules. After macerating the stomach in the acid for a sufficient length of time it is washed in water and then placed in a saturated aqueous solution of alum, where it may be kept indefinitely. To isolate the tubules a small portion of the mucous membrane is teased on a slide with needles, stained, and mounted in glycerin jelly.

PICRIC ALCOHOL METHOD.

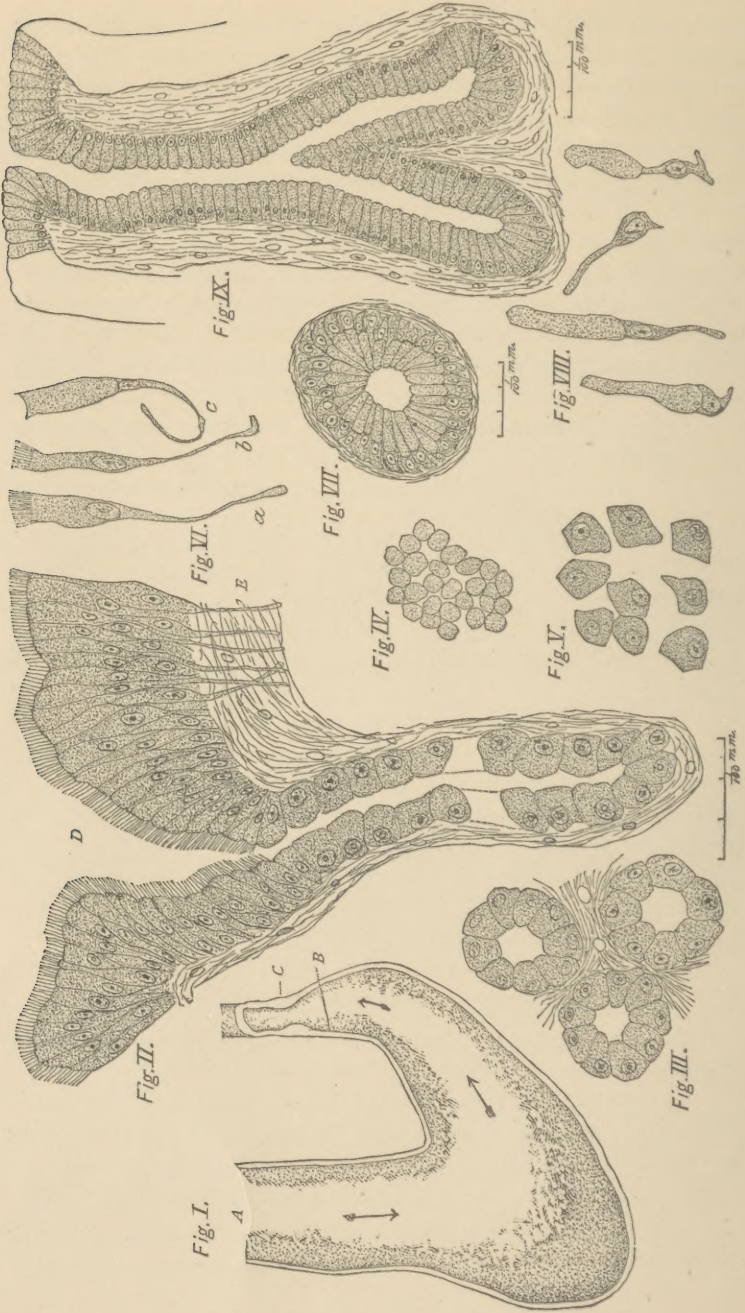
For isolating epithelial cells this method serves most admirably. The tissue is placed in 25 per cent. alcohol, to which a little picric acid has been added (95 per cent. alcohol, 25 c. c. ; water, 75 c. c. ; picric acid, $\frac{1}{10}$ gram) for a few hours, or until the cells can be easily isolated. The epithelium must not be left in the picric alcohol too long, otherwise the cells will deteriorate. Preserve in glycerin or glycerin jelly.

MERCURIC CHLORIDE METHOD.

I prefer this method to all others for hardening the stomach for sectioning. The stomach is fastened to cork, with pins previously coated with vaseline to prevent their being corroded by the mercuric chloride, and immersed in a saturated aqueous solution of mercuric chloride plus $\frac{1}{2}$ per cent. sodium chloride (Na Cl, $\frac{1}{2}$ gram ; Hg Cl₂, 5 grams ; H₂ O, 100 c. c.) for $\frac{1}{2}$ to 2 hours ; a longer time does no harm. From the mercuric chloride transfer directly to 70 per cent. alcohol, to which a little tincture of iodine has been added. The tissue is washed in this till the alcohol ceases to lose color ; then it is transferred to 75 per cent. alcohol, and finally to 95 per cent. alcohol for one day. Care must be taken to wash the tissue thoroughly in order to remove all the mercuric chloride, otherwise needle-like crystals will form in the specimens. The tissue may be imbedded either in paraffin or collodion.

Bibliography.

1. Duméril, Aug. Histoire Naturelle des Poisons ou Ichthyologie Général, (Ganoides, Dipnés, Lophobranches). Tome second. (Paris, 1870.)
2. Edinger, Ludwig. Ueber die Schleimhaut des Fischdarmes nebst Bemerkungen zur Phylogense der Drüsen des Darmrohres. Archiv für mikroskopische Anatomie, vol. xiii, p. 651, 1877.
3. Franque, Henricus. Amiæ calvæ Anatomiam. Berlin, 1847.
4. Trinkler, Nikolai. Ueber den Bau der Magenschleimhaut. Archiv für mikroskopische Anatomie, vol. xxiv, p. 174, 1885.



Description of Plate.

The outlines of all the drawings, except Fig. I, were made by the aid of Abbé's camera lucida.

Fig. I.—This figure was made from a specimen slightly distended with alcohol. A portion of the walls have been cut away so as to show the extent of the ciliated epithelium and the direction of the ciliary currents.

A—Beginning of cesophagus.

B—Point where the cilia disappear.

C—Pylorus.

The direction of the ciliary currents is represented by the arrows.

Fig. II.—Cardiac gastric gland.

D—Mouth of the gland, showing the depth to which the ciliated epithelium extends into it.

E—Thread-like continuations of the epithelial cells extending into the mucosa.*

Fig. III.—Transection of cardiac gastric glands.

Fig. IV.—Ends of epithelial cells as seen in surface views of the mucous membrane.

Fig. V.—Isolated cells of a cardiac gastric gland.

Fig. VI.—Isolated cells from the surface epithelium of the stomach.

a, b—Ciliated epithelial cells.

c—Beaker cell.

Fig. VII.—Transection of pyloric gland.

Fig. VIII.—Isolated cells of the deeper part of a pyloric gland.

Fig. IX.—Pyloric gland, showing two glands opening into a single mouth.

(Figs. II, III, IV, V, VI, and VIII were all drawn on the same scale. Figs. VII and IX were drawn on a smaller scale.)

*This was not actually demonstrated, but from the fact that the epithelial cells are much longer than the apparent thickness of the epithelium I believe that the figure gives a correct idea of the actual condition of things.

